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Title:

REEL FOR METALLIC WIRE

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REEL FOR METALLIC WIRE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a reel around which metallic wire is wound. More particularly, the present invention relates to a reel for metallic wire capable of inhibiting break in a winding drum of the reel due to a winding force generated by winding the metallic wire around the reel, and of inhibiting break in a joint portion between the winding drum and a flange of the reel.

Description of the Related Art

[0002] In general, as shown in Figs. 9 and 10, a reel 21 for metallic wire comprises a winding drum 22 around which metallic wire is wound and a pair of flanges 23 provided on both ends of the winding drum 22. The winding drum 22 and the pair of flanges 23 are made of thick steel such as structural carbon steel (e.g., S45C). According to a manufacturing method, the reel is classified into an integral reel (precut reel) obtained by precutting the winding drum 22 and the flanges 23 to be integral one, and a welded reel (assembly reel) obtained by manufacturing the winding drum 22 and the flanges 23 independently and by welding the winding drum 22 and the flanges 23.

[0003] When the metallic wire, for example, extremely thin metallic wire for wire saw having a diameter of 0.12 to 0.16mm (or less), or extremely thin metallic wire (sometimes including steel cord) having a diameter of about 0.15 to 0.40mm as element wire of twisted wire steel cord (tire cord) for reinforcing rubber product, is wound around the reel with a predetermined winding force (e.g., 0.4kg to 1.5kg), a large tightening force due to the winding force is applied to the winding drum 22.

[0004] In the case of the reel configured such that a diameter L of the flanges 23 is larger than a width H of the winding drum 22 ($\mathbf{H < L}$ see Fig. 9), namely, "slim-type reel", a pressure (side pressure) applied to the flange 23 is much larger than a winding pressure applied to the winding drum 22. As represented by a dotted line in Fig. 9, this pressure acts to cause the flanges 23 to be deformed to be away from each other.

[0005] The side pressure is larger when the diameter of the metallic wire is smaller, the winding force is larger, and the number of times the metallic wire is wound around the drum is larger. In the case of the extremely thin metallic wire, for example, the metallic wire for

wire saw, the metallic wire with weight of 40 to 60kg or larger is wound around the reel. In this case, the side pressure sometimes increases up to several tons or several tens tons.

[0006] As a result, in the case of the slim-type reel, a stress concentrates on a joint portion **Y** between the winding drum 22 and the flange 23 and break occurs at the joint portion **Y**. Accordingly, in the reel of such a shape, it is necessary to reinforce the joint portion **Y** between the winding drum 22 and the flange 23. In the case of the reel manufactured by welding the winding drum 22 and the flange 23, the stress (side pressure) is not completely absorbed at the welded portion, and therefore it is highly probable that the welded portion is broken. Accordingly, the reel of such a shape is required to reinforce the winding drum 22 and the flange 23 and inhibit break at the joint portion **Y** between the winding drum 22 and the flange 23.

[0007] On the other hand, in the case of the reel in which the width **H** of the winding drum 22 is larger than the diameter L of the flange 23 (**L < H**, see Fig. 10), namely, an elongate-drum reel, the above-mentioned large tightening force applied to the winding drum 22 due to the winding force concentrates on the winding drum 22 rather than the flanges 23. The tightening force (winding pressure) causes the winding drum 22 to be deformed so as to reduce the diameter at a center portion thereof (as indicated by a dotted line in Fig. 10). The deformation causes the flanges 23 to be deformed to be bent inwardly. Accordingly, the reel of such a shape is also required to reinforce the winding drum 22.

[0008] Conventionally, the reel is made of thick steel having a thickness of about 20 to 50 mm for the purpose of comprising strength or rigidity to withstand the side pressure. For this reason, the conventional reel has heavy weight and is difficult to handle, and a transportation cost is high. In addition, a material cost or machining cost are high.

[0009] Even in the reel having such a strong structure, the flanges or the winding drum are inevitably plastically deformed by a tremendous side pressure. With repeated use of the reel several times or several tens times, the reel is deformed acceleratively, or the reel is broken and becomes unusable. In brief, the conventional reel does not have durability regardless of its high cost. A reel that has solved such a problem is disclosed in Japanese Laid-Open Patent Application Publication No. Hei. 11 - 114798 (page 3, Fig. 1), which is hereinbelow referred to as a document 1.

[0010] Furthermore, a reel intended to reinforce a winding drum by providing a reinforcement member on an inner side of the winding drum, is disclosed in Japanese Laid-

Open Patent Application Publication No. 2001 - 206636 (page 2, Fig. 3), which is hereinbelow referred to as a document 2.

[0011] As shown in Fig. 11, the reel disclosed in the document 1 comprises a barrel portion 31 around which saw wire is wound, flange portions 32 provided on both ends of the barrel portion 31, and a filling member 33 pressed into an inside hollow portion of the barrel portion 31. The filling member 33 serves to inhibit deformation of the reel. The filling member 33 is made of a material that has weight lighter than steel and a reasonable compressive strength and is held by lid members 34. In Fig. 11, reference numeral 35 denotes male screws with which the lid members 34 are secured to end portions of the flange portions 32.

[0012] In the reel for metallic wire in Fig. 11, while the barrel portion 31 (winding drum) is tightened by the winding force of the metallic wire, the filling member 31 pressed into the inside hollow portion of the barrel portion 31 acts against the tightening force applied to the barrel portion 31 to inhibit deformation of the barrel portion 31. However, its structure is complex, and the filling member 33 is needed. This disadvantageously increases cost and weight.

[0013] As shown in Fig. 12, the reel disclosed in document 2 is structured such that ring-shaped reinforcement plates 43 are provided on an inner side of a winding drum 41. Reference numeral 42 denotes flange portions. In this reel, reinforcing effect is lessened at a portion of the winding drum 41 away from the reinforcement plates 43, and hence, strength of the winding drum 41 is locally reduced if the reinforcement plates 43 are fewer. However, if the number of reinforcement plates 43 is increased, a manufacturing cost becomes high and manufacturing steps are increased, which leads to reduced work efficiency.

[0014] Under the circumstances, the present invention has been made, and an object of the present invention is to provide a reel for extremely thin metallic wire that can solve the above-mentioned problems associated with the conventional reel for metallic wire, that is, a reel that is lightweight and inexpensive and has sufficient strength and reusability.

SUMMARY OF THE INVENTION

[0015] According to the present invention, there is provided a reel for metallic wire comprising a cylindrical winding drum; and a pair of flanges provided integrally on right and left sides of the cylindrical winding drum, wherein a winding face of the cylindrical winding drum is wrapped by a cylindrical drum cover plate provided with a gap between the drum

cover plate and the winding face and configured to cover substantially entire periphery of the winding face, and the drum cover plate has a discontinuous portion to absorb a winding pressure applied to the drum cover plate. Thereby, it is possible to inhibit break of the winding drum of the reel due to the winding force generated by winding the metallic wire around the reel.

[0016] The reel of the present invention comprises the winding drum having a double-walled structure comprised of the winding face of a reel body and a cylindrical drum cover plate, and the drum cover plate is provided with the gap between the drum cover plate and the winding face of the reel body. In this structure, while the metallic wire is wound around the reel, the drum cover plate is elastically deformed flexibly by a large tightening force applied to the winding drum. In addition, since the discontinuous portion formed in the drum cover plate functions to absorb elastic deformation of the drum cover plate, most of a large tightening force applied to the winding drum is absorbed by the drum cover plate. In accordance with the present invention, it is possible to inhibit the center portion of the winding drum from being deformed to reduce the diameter by the large tightening force applied the winding drum when the metallic wire is wound around the reel. As a result, durability of the reel is improved.

[0017] It would be preferable that the drum cover plate is comprised of a pair of drum cover plate portions each having a free end and a base end and each having a semicircular cross-section, and the drum cover plate is placed to wrap substantially the entire periphery of the winding face of the winding drum by attaching the drum cover plate portions to the winding face of the winding drum and then by welding the base ends to each other to form the discontinuous portion between the free ends.

[0018] It would be preferable that the drum cover plate is comprised of a pair of drum cover plate portions each having a semicircular cross-section, and the drum cover plate is placed to wrap substantially the entire periphery of the winding face of the winding drum by welding joint end faces of the drum cover plate portions to each other so as to form the discontinuous portion at a boundary where the pair of drum cover plate portions are divided into right and left parts, the discontinuous portion extending over an entire circumference of the drum cover plate.

[0019] In the above-described configuration, since the drum cover plate can be easily attached to the existing reel, the drum cover plate can be changed and the reel becomes

usable semipermanently. In addition, an unusable reel having deformed winding drum can be restored to a usable one by attaching the drum cover plate to the winding drum.

[0020] According to the present invention, there is provided a reel for metallic wire comprising a cylindrical winding drum; and a pair of flanges provided integrally on right and left sides of the winding drum, wherein a winding face of the cylindrical winding drum is wrapped by a cylindrical drum cover plate provided with a gap between the drum cover plate and the winding face and configured to cover substantially entire periphery of the winding face, a corner plate having a L-shaped cross-section is provided at a joint portion between the winding drum and each of the flanges, a flange contact plate having a ring-shaped planar shape is fixed to an inner face of each of the flanges, an inner peripheral portion of each of the flange contact plates is welded to an end portion of a vertical portion of each of the corner plates, and an outer peripheral portion of the drum cover plate is welded to an end portion of a horizontal portion of each of the corner plates.

[0021] The reel of the present invention comprises the winding drum having a double-walled structure comprised of the winding face of the reel body and the cylindrical drum cover plate, and the drum cover plate is provided with the gap between the drum cover plate and the winding face of the reel body. In this structure, when the metallic wire is wound around the reel, the drum cover plate is elastically deformed flexibly by a large tightening force applied to the winding drum. Thus, in accordance with the present invention, the cylindrical drum cover plate is capable of inhibiting the center portion of the winding drum from being deformed to reduce the diameter by the large tightening force applied to the winding drum when the metallic wire is wound around the reel. In addition, stress caused by strain due to welding generated by welding the end portion of the vertical portion of the corner plate to the inner peripheral portion of the flange contact plate, remains as stress to pull the flange inwardly in manufacturing the reel. In other words, initial stress to pull the flange inwardly resides in manufacturing the reel. The initial stress acts to inhibit the flanges from being expanded to be away from each other by the side pressure. Further, the corner plate provided at the joint portion between the winding drum and the flange functions to inhibit occurrence of break at the joint portion. By interaction of these components, durability of the reel can be improved.

[0022] By forming a discontinuous portion in the drum cover plate, most of the large tightening force applied to the winding drum can be absorbed by the drum cover plate, because the discontinuous portion absorbs elastic deformation of the drum cover plate.

[0023] Also, by forming an inner face of a L-shaped bent portion of the corner plate in an arc shape, concentration of the stress can be avoided.

[0024] It would be preferable that a spiral structure made of steel is formed on an inner side of the cylindrical winding drum. Since the spiral structure formed on the inner side of the winding drum serves to uniformly reinforce the winding drum from inside, rigidity of the reel is increased, and the winding pressure and the side pressure are absorbed. This makes it possible to improve rigidity of the reel and further improve the function of the reel to absorb the winding pressure and the side pressure.

[0025] In accordance with the present invention, the effects described below are obtained.

[0026] i) Since the winding drum has a double-walled structure comprised of the winding face of the reel body and the cylindrical drum cover plate, and the drum cover plate is provided with the gap between the drum cover plate and the winding face of the reel body, the drum cover plate is elastically deformed flexibly by the large tightening force applied to the winding drum, when the metallic wire is wound around the reel. In addition, since the discontinuous portion formed in the drum cover plate functions to absorb elastic deformation of the drum cover plate, most of a large tightening force applied to the winding drum is absorbed by the drum cover plate. Therefore, it is possible to inhibit the center portion of the winding drum from being deformed to reduce the diameter by the large tightening force applied to the winding drum when the metallic wire is wound around the reel, and restrain deformation of the reel in use due to the winding pressure within an elasticity limit of reel components. As a result, durability of the reel can be improved.

[0027] ii) Since the winding drum has a double-walled structure comprised of the winding face of the reel body and the cylindrical drum cover plate, it is possible to restrain deformation of the reel in use due to the winding pressure within the elasticity limit of reel components as described above. In addition, by strain due to welding generated by welding the end portion of the vertical portion of the corner plate to the inner peripheral portion of the flange contact plate, initial stress to pull the flange inwardly resides in manufacturing the reel, and acts to inhibit the flanges from being expanded to be away from each other by the side pressure. Further, the corner plate provided at the joint portion between the winding drum and the flange serves to avoid break at the joint portion, and interaction of these components can improve durability of the reel.

[0028] iii) Since the drum cover plate, the corner plates and the flange contact plates can be easily attached to and detached from the existing reel, and can be changed, the reel becomes usable semipermanently.

[0029] iv) An unusable reel having a deformed winding drum can be restored to a usable one by attaching the drum cover plate to the winding drum.

[0030] v) Since the drum cover plate can be divided at desired positions, the drum cover plate can be easily detached and changed. So, when the drum cover plate has been deformed, the reel becomes usable semipermenently by replacing the deformed drum cover plate by a new one.

[0031] vi) The spiral structure provided on the inner side of the winding drum can enhance the function to absorb the winding pressure and the side pressure. Since this reel for metallic wire is created by welding the spiral structure to the inner side of the winding drum, manufacturing efficiency is high and manufacturing cost is low.

[0032] The above and further objects and features of the invention will more fully be apparent from the following detailed description with accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] Fig. 1 is a cross-sectional view of a reel for metallic wire according to a first embodiment of the present invention;

[0034] Fig. 2 is a cross-sectional view of main components of the reel in Fig. 1;

[0035] Fig. 3 is a perspective view of the main components of the reel in Fig. 1;

[0036] Fig. 4A is a view showing a test result of reusability of the reel of the present invention;

[0037] Fig. 4B is a view showing a test result of reusability of the conventional reel;

[0038] Fig. 5A is a perspective view of an embodiment of a drum cover plate;

[0039] Fig. 5B is a perspective view of another embodiment of the drum cover plate;

[0040] Fig. 6A is a side view of a slim-type reel;

[0041] Fig. 6B is a side view of an elongate-drum reel;

[0042] Figs. 6C to 6E are schematic views showing examples of a discontinuous portion (slit);

[0043] Fig. 7 is a side cross-sectional view of a reel for metallic wire according to a second embodiment of the present invention;

[0044] Fig. 8A is a side view of a spiral structure;

[0045] Fig. 8B is a front view of the spiral structure;

[0046] Fig. 9 is a side view of the conventional slim-type reel;

[0047] Fig. 10 is a side view of the conventional elongate-drum reel;

[0048] Fig. 11 is a cross-sectional view of the conventional high-strength reel;

[0049] Fig. 12 is a cross-sectional view of the conventional reel for metallic wire having a reinforced winding drum;

[0050] Fig. 13 is a view for explaining an effect of the reel for metallic wire according to the second embodiment of the present invention; and

[0051] Fig. 14 is a view for explaining an effect of the conventional reel for metallic wire shown in Fig. 12.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0052] Hereinafter, embodiments of the present invention will be described with reference to the drawings.

(Embodiment 1)

[0053] Referring now to Figs. 1 to 3, reference numeral 10 denotes a reel for metallic wire. The reel 10 for metallic wire comprises a cylindrical winding drum 1 and flanges 2 provided integrally on right and left sides of the winding drum 1.

[0054] A winding face **1a** of the winding drum 1 is wrapped by a cylindrical drum cover plate 5 provided with a gap **a** between the drum cover plate 5 and the winding face **1a**. The cylindrical drum cover plate 5 can cover substantially the entire periphery of the winding face **1a**. The drum cover plate 5 is provided with a discontinuous portion 6 for absorbing a winding pressure applied to the drum cover plate 5. In the reel shown in Fig. 1, the discontinuous portion 6 is comprised of a slit 7 (see Figs. 2 and 3) having a slight gap.

[0055] As shown in Fig. 2, the slit 7 is configured such that an axis **Z - Z** thereof extends in the direction perpendicular to an axis **Y - Y** of the winding drum 1. It should be appreciated that substantially the same function and effects are obtained in the case where the

axis **Z - Z** of the slit 7 is inclined to a certain angle from vertical. As shown in Fig. 6A, in the case of the reel (slim-type reel) in which a diameter **L** of the flange 2 is larger than a length **H** of the winding drum 1, the ability of the drum cover plate 5 to absorb the winding pressure can be increased by setting the axis **Z - Z** of the slit 7 as shown in Fig. 2, because a pressure **B** applied to the flange 2 is larger than a pressure **A** applied to the winding drum 1.

[0056] Alternatively, as shown in Fig. 6B, the slit 7 may be configured such that the axis thereof extends in the direction parallel to the axis of the winding drum 1. As shown in Fig. 6B, in the case of an "elongate-drum reel" in which a diameter $\mathbf{L_1}$ of the flange 2 is smaller than a length $\mathbf{H_1}$ of the winding drum 1, the ability of the drum cover plate 5 to absorb the winding pressure is increased by setting the axis of the slit 7 parallel to the axis of the winding drum 1, because the pressure **B** applied to the flange 2 is smaller than the pressure **A** applied to the winding drum 1. It should be appreciated that substantially the same function and effects are obtained in the case where the slit 7 is inclined to a certain angle from parallel with respect to the axis of the winding drum 1.

[0057] In the examples shown in Figs. 6A and 6B, 2 and 3, the slits 7 are formed to be curved in a continuous sine curve shape as seen in a plan view. The shape of the slit 7 is not intended to be limited to the sine curve, which will be described later.

[0058] In manufacturing the reel 10 (before the flanges 2 are attached to the winding drum 1), the drum cover plate 5 is easily attached from lateral direction (or from vertical direction) of the winding drum 1.

[0059] In the case where the drum cover plate 5 is attached to the existing reel, as shown in Fig. 5A, a pair of half parts 5A and 5B forming the drum cover plate 5 and each having a semicircular cross-section are brought into contact with each other from external direction (or vertical direction) of the winding drum 1, and then their opposed faces are welded to each other.

[0060] As shown in Figs. 2, 3, and 6A, the half-parts 5A and 5B are divided into right and left parts at the slit 7. The half-parts 5A and 5B are brought into contact with each other from the vertical direction of the winding drum 1 and are thereafter welded to each other. The slit 7 extends over the entire circumference of the drum cover plate 5. **'W'** denotes a welding line. Fig. 5B is a perspective view of the drum cover plate 5 shown in Figs. 2, 3, and 6A.

[0061] In the structure shown in Fig. 6B, as shown in Fig. 5A, the drum cover plate 5 is formed by a pair of half parts 5A and 5B each having a semicircular cross-section, which are

brought into contact with each other from external of the winding drum 1. In this example, opposed side edge faces 5a of the half-parts 5A and 5B on one side are straight-line shaped as seen in a plan view, and opposed side edge faces 5b of the half-parts 5A and 5B on the other side are curved in continuous sine curve shape as seen in a plan view. By welding the side edge faces 5a to each other, the cylindrical drum cover plate 5 is formed, and the slit 7 is formed between the side edge faces 5b with a predetermined gap **d**.

[0062] In this manner, the drum cover plate 5 is easily attached to the existing reel.

[0063] The drum cover plate 5 incorporated into the winding drum 1 is cut and divided at the welding line **W**, and hence easily detached and changed. This cutting is, off course, possible at a location other than the welding line **W**. When the drum cover plate 5 has been deformed, the drum cover plate 5 is easily cut and removed from the winding drum 1. The removed drum cover plate 5 is replaced by another drum cover plate 5. In this manner, the reel becomes usable semipermanently. Besides, an unusable reel having a deformed winding drum 1 can be restored to a usable reel by attaching the drum cover plate 5 to the winding drum 1.

[0064] The reel of this embodiment comprises the winding drum 1 having a double-walled structure comprised of the winding face **1a** of a reel body and the cylindrical drum cover plate 5. In addition, the drum cover plate 5 is provided with the gap **a** between the drum cover plate 5 and the winding face **1a**. In such a structure, when a large tightening force is applied to the winding drum 1 while the metallic wire is wound around the reel, the drum cover plate 5 is elastically deformed flexibly by the tightening force. In addition, since the discontinuous portion 6 (slit 7) formed on the drum cover plate 5 functions to absorb elastic deformation of the drum cover plate 5, most of the large tightening force applied to the winding drum 1 is absorbed by the drum cover plate 5. In accordance with the reel of this embodiment, a center portion of the winding drum 1 is inhibited from being deformed to reduce a diameter by large tightening force applied to the winding drum 1 while the metallic wire is wound around the reel. As a result, durability of the reel can be improved.

[0065] In addition to a smooth curve (e.g., sine curve) shown in Fig. 6C, the shape of the slit 7 may be continuous triangular-wave shown in Fig. 6D as seen in a plan view, or straight-line shown in Fig. 6E as seen in a plan view. Substantially the same effects are obtained with the use of any of these shapes.

[0066] The drum cover plate 5 is compressed or expanded when the winding pressure is applied to or released from the drum cover plate 5. In this case, elastic deformation amount increases with an increase in compression or expansion amount. Since the compression or expansion amount is proportional to a dimension (set effective dimension) **C** of the slit 7 which is perpendicular to the axis thereof (see Fig. 6C), the dimension **C** is preferably large.

[0067] In view of the above, the use of the slits 7 in Figs. 6C or 6D is advantageous, because the drum cover plate 5 with the slit 7 in Fig. 6C or 6D is elastically deformed more greatly than the drum cover plate 5 with the slit 7 in Fig. 6E, and is capable of absorbing the winding pressure applied to the winding drum 1 more than the drum cover plate 5 with the slit 7 in Fig. 6E. Nonetheless, the slit in Fig. 6E is manufactured at an extremely low cost.

[0068] The drum cover plate 5 with slit 7 in Fig. 6D has compression or expansion amount range substantially equal to that of the drum cover plate 5 with the slit 7 in Fig. 6C, and serves to sufficiently absorb the winding pressure. But, the shape of the slit 7 in Fig. 6D is pointed (in the vicinity of a top of the triangular-wave shape), and this pointed portion tends to be deformed, for example, upcurved while the metallic wire is wound. Further, the wire tends to be cut into the pointed portion of the slit 7. Such a reel is undesirable as the reel for extremely thin metallic wire. But, the slit in Fig. 6D is manufactured more easily than the slit in Fig. 6C, and hence at a lower cost.

[0069] Which of the slits 7 is used should be determined depending on the above-described advantages and disadvantages.

[0070] As defined herein, the term "sine curve" means to include a smooth continuous curve such as a sine curve.

[0071] As a matter of course, the gap **d** of the slit 7 (see Figs. 5A and 5B) is set to inhibit the opposed edges of the slit 7 from being brought into contact with each other by deformation of the drum cover plate 5.

[0072] The reel 10 shown in Figs. 1 to 3 is configured such that corner plates 3 having L-shaped cross-section are each provided at a joint portion between the winding drum 1 and each of the flanges 2 on both sides of the drum cover plate 5 as described later. The corner plates 3 having L-shaped cross-section may be omitted in the reel intended to only inhibit break of the winding drum 1. By extending the drum cover plate 5 substantially over the whole length of the winding drum 1 in such a reel, deformation or break of the winding drum 1 is inhibited more effectively.

[0073] As described above, the reel 10 shown in Figs. 1 to 3 is provided with the corner plates 3 at the joint portions (as represented by **Y** in Fig. 9) between the winding drum 1 and the flange 2 on both sides of the drum cover plate 5. And, flange contact plates 4 are respectively attached to inner faces of the flanges 2. The flange contact plates 4 have ring-shaped planar shape.

[0074] The flange contact plates 4 are each fixed to the inner face of each of the flanges 2. Preferably, the flange contact plate 4 is fixed to the inner face of the flange 2 by means of welding or bolts and nuts. In the reel 10 in Figs. 1 and 2, the flange contact plate 4 is fixed to the inner face of the flange 2 by spot welding $\mathbf{W_1}$.

[0075] The corner plate 3 having L-shaped cross-section is formed so that an end portion of a horizontal portion thereof is welded to an outer peripheral portion of the drum cover plate 5 as represented by $\mathbf{W_2}$ and an end portion of a vertical portion thereof is welded to an inner peripheral portion of the flange contact plate 4 as represented by **W3**.

[0076] Preferably, a bent portion **X** (see Fig. 1) of the corner plate 3 has an arc-shaped inner face. This is because the arc-shaped inner face can avoid concentration of stress.

[0077] The corner plates 3 and the flange contact plates 4 are attached to the reel 10 in the same manner as the drum cover plate 5. In manufacturing the reel, i.e., before the flange 2 is attached to the winding drum 1, the corner plates 3 and the flange contact plates 4 are easily attached from external of the winding drum 1.

[0078] When the corner plates 3 and the flange contact plates 4 are attached to the existing reel, each of the corner plates 3 and the flange contact plates 4 is divided into a pair of semicircular half-parts. Then, these semicircular half-parts are brought into contact with each other and welded to each other as represented by $\mathbf{W_4}$ **and** $\mathbf{W_5}$ as shown in Fig. 3. Then, they are welded and fixed to the drum cover plate 5 or the flange 2.

[0079] In this manner, the corner plates 3 and the flange contact plates 4 can be easily attached to the existing reel, and in a reversed manner, these members can be easily detached therefrom. Thus, the drum cover plate 5, the corner plates 3 and the flange contact plates 4 can be easily changed, and as a result, the reel becomes usable semipermanently.

[0080] Preferably, the corner plates 3 and the flange contact plates 4 are attached to the reel in the order of : i) the flange contact plate 4 is fixed to the inner face of the flange 2, ii) the horizontal end portion of the corner plate 3 is welded to the outer peripheral portion of the

drum cover plate 5 (W_2), and iii) the vertical end portion of the corner plate 3 is welded to the inner peripheral portion of the flange contact plate 4 as represented by (W_3), because high work efficiency is gained.

[0081] In the reel 10 structured as described above, the flange portion has a double-walled structure comprised of the flange 2 and the flange contact plate 4. The double-walled structure increases rigidity of the flange portion. Further, since the end portion of the vertical portion of the corner plate 3 is welded to the inner peripheral portion of the flange contact plate 4, tensile stress to pull the flanges 2 inwardly, which is caused by strain due to welding occurring in welding, remains in the vicinity of the welded portion, and allows the flange 2 to be kept to be pulled inwardly after manufacture. In other words, the reel 10 of this embodiment has initial stress to pull the flange 2 inwardly.

[0082] The initial stress acts to inhibit the flanges 2 from being expanded to be away from each other by the side pressure. Therefore, the initial stress can inhibit the flanges 2 from being deformed to be away from each other by the pressure (side pressure) applied to the flanges 2, when the metallic wire is wound around the reel 10.

[0083] Further, the corner plate 3 provided at the joint portion between the winding drum 1 and the flange 2 is resistant to the side pressure applied to the corner plate 3, and its elasticity serves to restore the flange 2 with the bent portion **X** of the corner plate 3 (see Fig. 1) being as a center, and inhibit occurrence of damage at the bent portion **X**.

[0084] By combining the double-walled structure of the flange portion, the corner plate 3 provided at the joint portion between the winding drum 1 and the flange 2, welding of the end portion of the vertical portion of the corner plate 3 to the inner peripheral portion of the flange contact plate 4, and the cylindrical drum cover plate 5 having function to inhibit the center portion of the winding drum 1 from being deformed to reduce the diameter, it is possible to inhibit deformation and break of the reel when the metallic wire is wound around the reel, and in particular, inward deformation of the flange, and improve restorability of the reel 10 after unwinding the metallic wire. As a result, durability of the reel 10 is improved.

[0085] Fig. 4A is a view showing the relationship among a width of the winding drum 1 of the reel 10 (empty reel) for metallic wire of the present invention comprising the drum cover plate 5 having the discontinuous portion 6 for absorbing the winding pressure, the corner plates 3 and the flange contact plates 4 under the condition in which the wire is not wound around the reel 10, a width of the winding drum 1 of the reel 10 (full winding reel) around

which the metallic wire of 1.5 ton has been wound, and a width of the winding drum 1 of the reel 10 (reel after unwinding) after unwinding the metallic wire of 1.5 ton.

[0086] Fig. 4B is a view showing the relationship among a width of the winding drum 1 of the conventional reel (empty reel) for metallic wire without the drum cover plate 5, the corner plates 3, and the flange contact plates 4 under the condition in which the wire is not wound around the reel, a width of the winding drum 1 of the reel (full winding reel) around which the metallic wire of 1.5 ton has been wound, and a width of the winding drum of the reel (reel after unwinding) after unwinding the metallic wire of 1.5 ton.

[0087] When variation in the width of the winding drum is smaller, i.e., the expansion of the width of the winding drum occurring by winding the metallic wire around the reel is smaller, and the width of the winding drum after unwinding the metallic wire is equal to or closer to an initial width (width of the winding drum around which the metallic wire is not wound), the corresponding reel has good reusability and high durability.

[0088] As can be seen from Fig. 4A showing a test result of the reel 10 for metallic wire (1.5 ton reel provided with the corner plate 3 including the bent portion having a curved inner face), the dimension between the flanges is within elasticity limit after five-time use. This shows that the reel 10 for metallic wire has high durability.

[0089] On the other hand, as shown in Fig. 4B, in the case of the conventional reel for metallic wire incapable of inhibiting break of the reel, the flange is deformed beyond elasticity limit after the first use, and after the metallic wire is unwound, the reel is not restored to an original state. This means that the conventional reel for metallic wire can be used twice at most.

[0090] From comparison between Figs. 4A and 4B, the reel for metallic wire of the present invention has durability much higher than that of the conventional reel.

(Embodiment 2)

[0091] Subsequently, a second embodiment of the present invention will be described with reference to Figs. 7 and 8.

[0092] As shown in Fig. 7, the reel for metallic wire of the second embodiment is structured such that a spiral structure 11 is attached to an inner face of the cylindrical winding drum 1 of the reel for metallic wire of the first embodiment. The spiral structure 11 is formed by molding steel in a coil shape. The spiral structure 11 serves to reinforce the winding drum

1 from inside and is attached to the inner face of the cylindrical winding drum 1 by suitable means such as spot welding. In Fig. 7, 12 denotes axes and 13 denotes a reinforced part.

[0093] The spiral structure 11 is typically formed by steel having a rectangular cross-section (generally called flat bar), but the cross-section may be triangular or T-shaped. In this case, the spiral structure 11 formed by any of these steel has an outer peripheral flat face to be welded to the inner face of the winding drum 1.

[0094] In the conventional reinforcement-type reel for metallic wire shown in Fig. 12, ring-shaped plates 43 are subjected to more load. Therefore, when the winding pressure is applied to a winding drum 41 as shown in Fig. 12, the portion of the winding drum 41 where the ring-shaped plates 43 are not provided is deformed, so that the winding drum 41 is deformed to be corrugated as represented by a dotted line.

[0095] On the other hand, in the reel for metallic wire of the second embodiment, as shown in Fig. 13, part of the spiral structure 11 are always positioned on numerous cross-sectional lines **X - X** (innumerable cross-sectional lines **X - X**) perpendicular to the axis of the winding drum 1. In this structure, stress of the winding drum 1 per unit area is made uniform, and hence the winding drum 1 is less likely to be locally deformed. The spiral structure 11 with smaller pitch P (see Fig. 8) can enhance the above described effects, as a matter of course.

[0096] In assembling, the spiral structure 11 is manufactured in advance and welded to an inside of the winding drum 1. That is, one positioning of the spiral structure 11, i.e., reinforcement member is sufficient. On the other hand, in the reel for metallic wire in Fig. 12, positioning needs to be performed plural times for plural reinforcement plates 43 to be welded to the inner side of the winding drum 41. Therefore, the reel for metallic wire of the second embodiment advantageously offers high manufacturing efficiency and low manufacturing cost, in contrast with the reel in Fig. 12. In Fig. 12, 42 denotes the flange.

[0097] Numerous modifications and alternative embodiments of the invention will be apparent to those skilled in the art in the light of the foregoing description. Accordingly, the description is to be construed as illustrative only, and is provided for the purpose of teaching those skilled in the art the best mode of carrying out the invention. The details of the structure and/or function may be varied substantially without departing from the spirit of the invention.